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BUTANOL BLEND REDUCES POLLUTANTS IN SPARK IGNITION ENGINE

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ABSTRACT

Tests were taken to determine exhaust emissions of a petrol engine having cuprum sprayed engine [CuE, Cuprum of thick, 0.3 mm) sprayed on the top portion of the piston and interior portion of cylinder head] coupled with catalytic converter (CC) with iron of sponge as oxidizer with two fuels of petrol and petroleum mixed with butanol (85% petrol and 15% butanol by V) and correlated with data of standard engine (SE) with operation of petrol. The effects of variables of engine with variety of types of engine on engine products of exhaust emissions were studied. The products of exhaust of engine of monoxide of carbon (CO) and partially-burnt hydro carbon (UBHC) were studied with scientific indicators at various magnitudes of specific torque (BMEP) of the engine. The measurement of aldehydes followed with method of wet (DNPH) method. CC was coupled with engine with iron of sponge/ore of manganese as oxidizers. Facility for injection of air into CC was incorporated. The workability of oxidizers was judged. Reduction of exhaust products were noticed with butanol mixed with petrol. Injection of air in CC greatly affected exhaust products of engine.

KEYWORDS: Petrol Engine, Butanol, Cuprum Sprayed Engine & Products of Exhaust, and CC

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Original Article

1. INTRODUCTION

The number of automotive vehicles determines the extent of civilization. Depletion of petrol due to large use in transport of individual, one has to go for concept of alternative technology for fuel. Properties of alcohols are matched to those of petrol, in the aspect of octane number, hence, they can be conveniently used in petrol engine, with small quantities of blend, as large quantities may require changes in structure of the engine.

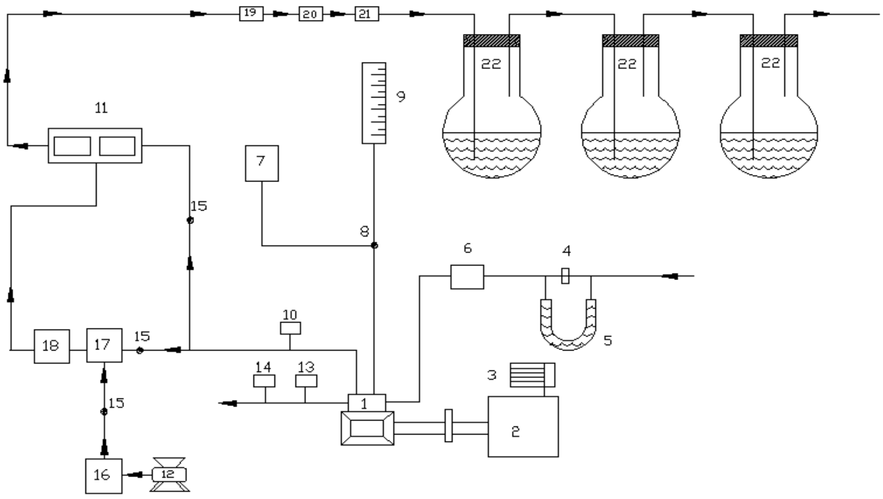
Respiratory problems occur with CO and UBHC levels. [Fulekar, 1999; Usha Madhuri, *et al.*, 2003**;** Khopkar, 2004], along with problems in environment. [Khopkar, 2004]. Importance is given to aldehydes, which cause deadly deceases, if engine is run with alcohol. Condition of the vehicles and layout of the traffic dictate the quantity of the pollutants. [Usha Madhuri, *et al.*, 2003]. Hence, urgent care is to be needed to cut down the exhaust products. Cuprum spraying on engine components is one method to improve workability of the engine as thermal conductivity of the material, cuprum is high causing reactivity in combustion. [Nedunchezhian, and Dhandapani, 2004**;**Murali Krishna *et al.*, 2010; Murali Krishna *et al.*, 2010]. CC is one technique to reduce exhaust products from SE [Murali Krishna et al., 2000; Murali Krishna *et al.*, 2008; Kishor *et al.*, 2010]. Many variables of CC affect the exhaust products engine along with engine variables. Mixing of petrol with alcohols dictates the exhaust products. [Murali Krishna *et al.*, 2005; Murali Krishna *et al.*, 2006; Murali Krishna *et al.*, 2007] Engine stratification along with fuel mixing with alcohol further reduced exhaust products. [Murali Krishna *et al.*, 2012].

No serious thought was given to reduce exhaust products with butanol mixed with petrol by changing engine variables. Tests were taken to control exhaust products with butanol mixed with petrol (80% petrol mixed with 20% butanol) with CuE. There was no mention of aldehydes in their report. [Indira Priyadarsini *et al.,* 2018]. More amount of butanol (grater than 15% by V) caused decrease of gas temperatures which lead to problems of combustion.

This report described exhaust products of CuE with two fuels of petrol and petrol mixed with butanol (petrol 85% and butanol 15% by V) with engine parameters and data was correlated with SE with operation of petrol. CC was coupled to engine to reduce exhaust products with iron of songe /ore of manganese.

2. MATERIALS AND METHODS

Figure1 describes investigation arrangement on CuE with butanol mixed petrol. Number of power cycles-2 per rotation, mono cylinder, ratio of compression 3-9, SE with petrol (output power 3 HP, at rotational speed of 60rps.). The output power was determined by output measuring device.



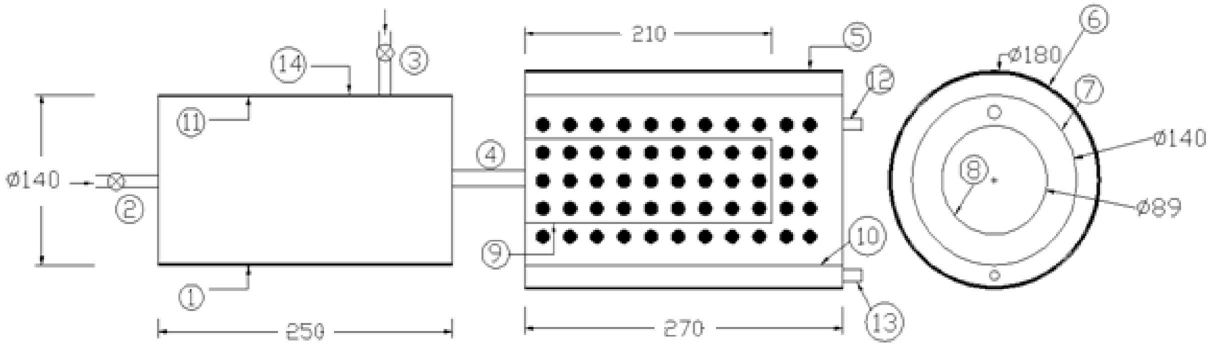
1. Engine, 2.Output measuring device, 3. Facility for load, 4. Device for measuring discharge
5. Measurement for head of water, 6. Chamber of air, 7. Container for fuel, 8. Rotating valve,
9. Measurement of consumption of fuel, 10. EGT reflector, 11 CO reflector, 12. Air pressurizer,
13. Reflector for outlet coolant temperature, 14. Flow rate measuring device for coolant,
15. Ball valve, 16. Flow rate device for air, 17. CC chamber of air, 18. CC chamber of catalyst,
19. Screening device, 20. Flow rate device, 21. Heating element, 22.container for DNPH.

Figure 1: Investigation Arrangement.

There was a facility to change the ratio of compression and speed of rotation with the principle of variable compression ratio engine. Thermocouple measured temperatures of exhaust. Burette method measured consumption of fuel while consumption of air was determined by chamber of air method. In CuE, top portion of the piston, and cylinder head inner surface were sprayed by cuprum. With the help of gun of plasma spray, a coating of bond of CO-Ni-Cr alloy was applied (thickness, 0.1 mm). Over coating of bond, Al (9.0%), Cu (90%), and Fe (1.0%) were sprayed (thick 0.3 mm). With this arrangement, the durability of coating was found to be high. [Nedunchezhian, and Dhandapani, 2004]. NC indicator measures CO and UBHC levels. Aldehydes were determined by method of wet. [Murali Krishna *et al.,* 2012]. Standard procedure was adopted as noted in Reference. [Murali Krishna *et al.,* 2012].

Outlet pipe of the engine was fitted with CC, (Figure.2) with cuprum as oxidizer. [Murali Krishna *et al.,* 2010].

Injection of air of quantity of 15 ml/s was incorporated in CC.



Note: Dimensions-mm.

1. Container for air, 2. Container for air inlet from exhaust manifold of the engine
3. Container for air inlet from pressurized chamber. 4. Container for air outlet. 5. Container for catalyst,
6. External container, 7. Container of intermediate, 8. Inner container, 9.Inner plate,
10.Intermediate plate, 11. Outer plate, 12. Exhaust gas outlet 13. Catalyst depositer, and, 14. Insulator

Figure 2: Parts of CC

Tests were taken on SE and CuE with two fuels with specified environment CC like Case-P without CC and without spray of air; Case-Q with CC and without spray of air, and Case-R with CC and with spray of air.

3. RESULTS AND DISCUSSIONS

3.1 Products of Exhaust

From Figure 3, it is learnt that ratio of compression affected CO levels, in two cases of the engines. As ratio of compression decreased, exhaust gas temperature increased in exhaust pipe leading for oxidation causing reduction of CO levels.

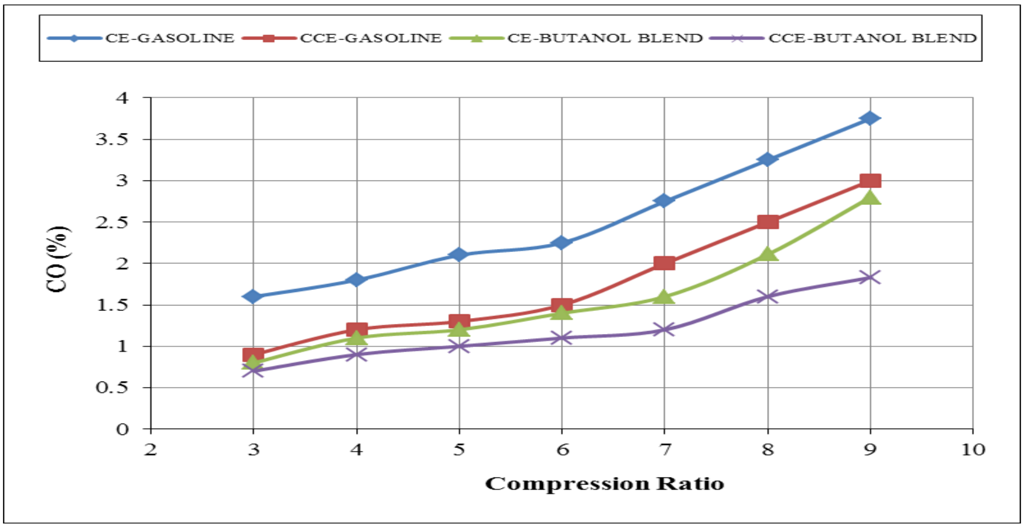


Figure 3: CO Vs Ratio of Compression.

Curves from Figure4 butanol mixed with petrol was better in reducing CO levels at different types of engine loading than neat petrol operation in two types of engines. Intensity of fuel reactions were dismissed with butanol. The numerical ratio of C to H_2 was less available with butanol in comparison with pure petrol thus releasing water vapor in exhaust. Theoretical fuel-air fuel ratio of butanol was higher as its oxygen container in fuel structure leading to improve activity of combustion, thus eliminating CO levels. Hydrogen was the product of combustion reaction with which velocity

of flame increased, which reduced CO levels. CO levels were lower with CuE when compared with SE. Combustion reaction improved with catalytic action of cuprum thus reducing CO levels.

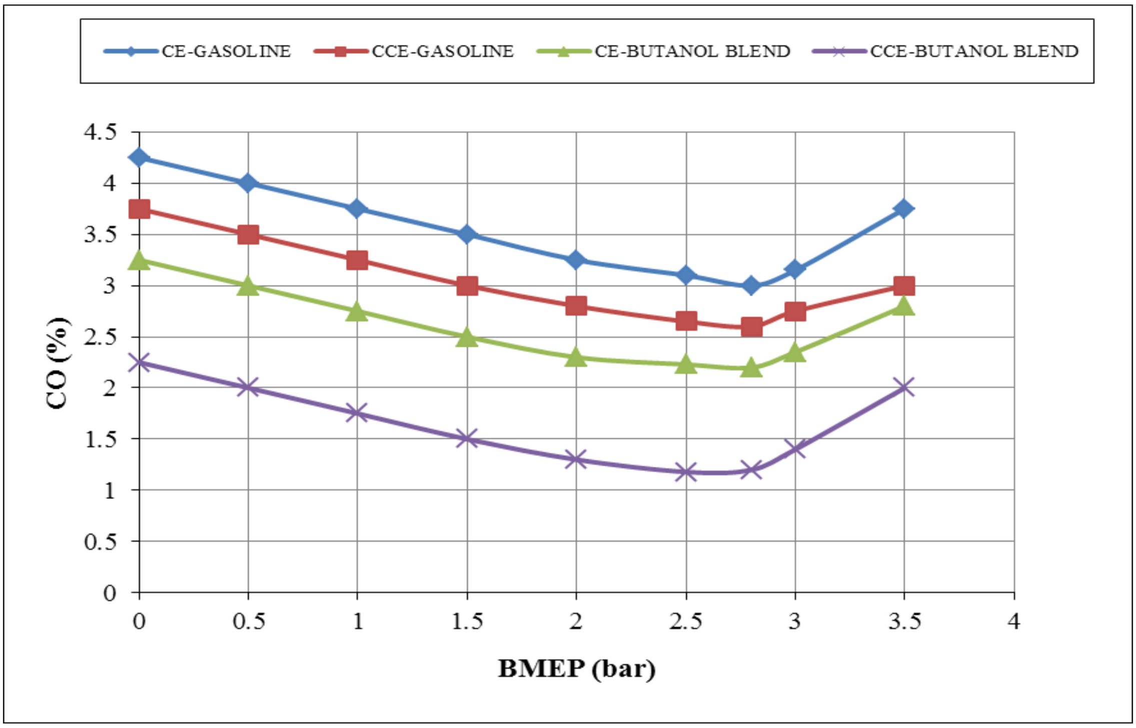


Figure 4: CO emissions Vs BMEP.

From Figure5, it is learnt that UBHC levels decreased with an increase of speed in two types of engines with increased reactivity.

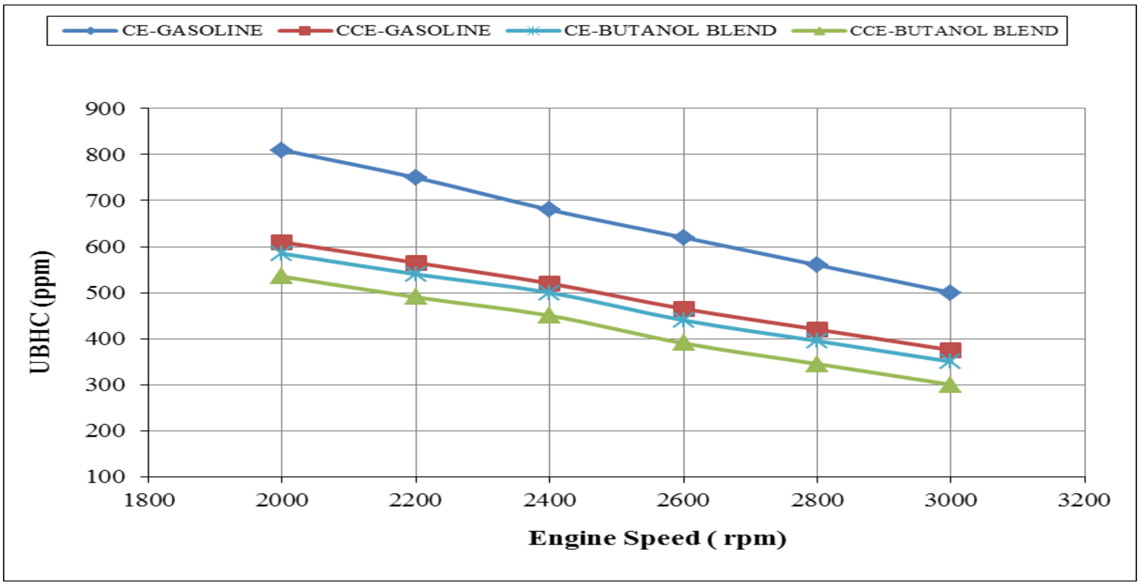


Figure 5: UBHC levels Vs Speed at a Ratio of Compression 9:1.

Figure 6 indicates that UBHC levels were the similar as those of CO emissions with two types of engines. Catalytic activity increased speed of flame coupled with reduction of quenching effect with CuE.

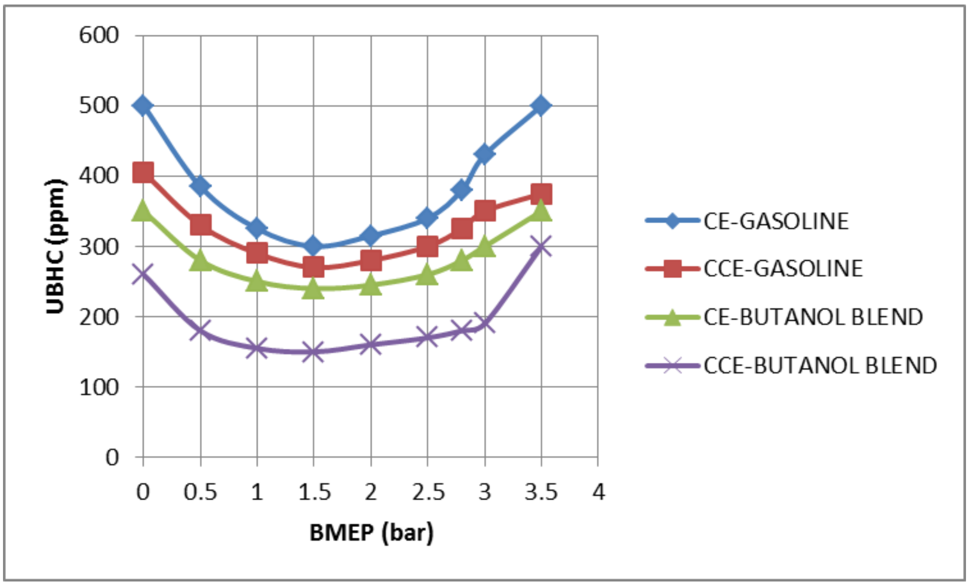


Figure 6: UBHC levels Vs BMEP.

CO emissions followed similar trends with UBHC emissions with speed of the engine with improved reactivity.

3.2 Catalytic Converter

From Table-1, it is learned that Case-Q operation are better in reducing CO levels when compared with Case-P operation. Meanwhile, Case-R operation still decreased exhaust product in two types of the engine with two fuels. Exhaust products got oxidized with catalytic reaction. Butanol mixed petrol reduced exhaust products than pure petrol in two types of engine. UBHC levels followed similar trend of those of CO levels in two types of engine with two fuels. Increased reactivity and reduction of effect of quenching might have decreased UBHC levels. Case-Q operation decreased aldehyde levels than Case-P operation with two types of engines and two types of fuels. Aldehyde levels drastically reduced with Case-R operation due to supply of oxygen causing oxidation reaction. Aldehyde emissions shoot up with butanol mixed with petrol than pure petrol operation. Aldehyde levels reduced with CuE than SE with butanol mixed with petrol. Increased combustion activity caused reduction of compounds of intermediate thus reducing aldehyde levels. Iron of sponge is better than manganese ore in cut down of pollutants, might be due to increase of area of surface.

Table 1: Data of Exhaust Emissions

Emissions	Set	Operation of Petrol				Butanol mixed petrol			
		SE		CuE		SE		CuE	
		S	M	S	M	S	M	S	M
CO (%)	Case-P	3.65	3.65	2.9	2.9	2.7	2.7	1.9	1.9
	Case-Q	2.15	2.69	1.7	2.12	1.6	1.8	1.5	1.7
	Case-R	1.4	1.76	1.1	1.41	0.9	1.1	0.8	1.0
UBHC (ppm)	Case-P	475	475	350	350	325	325	275	275
	Case-Q	275	235	180	240	170	200	125	180
	Case-R	175	215	85	120	125	180	70	115
Formaldehyde (Con. %)	Case-P	6.4	6.4	4.4	4.4	11	11	8.9	8.9
	Case-Q	4.4	4.8	2.4	2.8	5.5	6.0	5.0	5.5
	Case-R	2.4	2.8	1.4	1.8	4.7	5.3	3.3	3.7

Acetaldehyde (Con.%)	Case-P	5.4	5.4	3.4	3.4	9.9	9.9	6.5	6.5
	Case-Q	3.4	3.9	2.4	2.6	4.6	5.1	3.3	3.8
	Case-R	1.4	1.8	0.9	0.85	3.6	4.0	2.2	2.6

[S= Iron of Sponge, M= Ore of Manganese]

4. CONCLUSIONS

- Engine basis

  Cue drastically reduced exhaust product than SE

- Fuel basis

  Butanol mixed with petrol reduced exhaust products except aldehyde levels

- Speed basis

  Higher speeds of 60 rev per second reduced exhaust products.

- Ratio of compression basis

  Lower compression ratio decreased exhaust products. However, thermal efficiency was found to be optimum at ratio of compression of 9:1.

- CC basis

  Case-Q operation reduced exhaust products by 40%, while Case-R operation by 60%.

- Load of operation basis

  Load of 80% was found to be optimum for reduction of pollutants.

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REFERENCES

1. *Fulekar, M. H. (1999). Chemical pollution – a threat to human life. Indian J Env Tech. 1,353-359.*
2. *Indira Priyadarsini, Ch., Murali Krishna, M.V.S., Ipsita Mohanti., Nagini, Y., Narasimha Kumar, S. and Kishor, K. (2018).Control of exhaust emissions from copper coated spark ignition engine with butanol blended gasoline with catalytic converter with different catalyst. Pollution Research. 37(4),1104-1108.*
3. *Khopkar, S.M. (2004). Environmental Pollution Analysis, New Age International (P) Ltd, Publishers, New Delhi, 180-190.*
4. *Kishor, K., Murali Krishna, M.V.S., Gupta, A.V.S.S.K.S., Narasimha Kurmar, S. and Reddy,D.N. (2010).Emissions from copper coated spark ignition engine with methanol blended gasoline with catalytic converter. Indian Journal of Environmental Protection. 30(3):177–183.*
5. *Murali Krishna, M.V.S. and Kishor, M. (2008). Performance of copper coated spark ignition engine with methanol–blended gasoline with catalytic converter, Indian Journal of Scientific and Industrial Research. 67(7), 543–548.*
6. *Murali Krishna, M.V.S. and Kishor, K. (2005). Control of pollutants from copper coated spark ignition engine with methanol blended gasoline. Indian Journal of Environmental Protection.25(8),732–738.*

7. *Murali Krishna, M.V.S., Kishor, K. and V. Ramana Reddy, Ch. (2007). Control of carbon monoxide emission in spark ignition engine with methanol blended gasoline and sponge iron catalyst. Ecology, Environment and Conservation. 13 (4),735–739.*

8. *Murali Krishna, M.V.S., Kishor, K., Gupta, A.V.S.S.K.S., Narasimha Kumar, S. Reddy, D.N. (2010).Control of pollutants from copper coated spark ignition engine with gasohol. Pollution Research. 29(3), 391–395.*

9. *Murali Krishna, M.V.S., Kishor, K., Gupta, A.V.S.S.K.S., Narasimha Kumar, S. Reddy, D.N. (2010).Investigations on reduction of carbon monoxide in spark ignition engine with gasohol with catalytic converter. Ecology, Environment and Conservation. 16(3),389–393.*

10. *Murali Krishna, M.V.S., Kishor, K., Sahithi, A. and Kavya, B. (2006). Control of pollutants from copper coated spark ignition engine with gasohol. Indian Journal of Environmental Protection.26(8), 718–723.*

11. *Murali Krishna, M.V.S., Kishor,K., Gupta, A.V.S.S.K.S., Murthy, P.V.K. and Narasimha Kumar, S. (2012). Comparative studies on performance evaluation of a two stroke copper coated spark ignition engine with alcohols with catalytic converter. Journal of Renewable and Sustainable Energy Reviews. July, 16,6333–6339.*

12. *Murali Krishna, M.V.S., Vara Prasad, C.M. and V.Ramana Reddy, Ch. (2000). Studies on control of carbon monoxide emissions in spark ignition engine, using catalytic converter. Ecology, Environment and Conservation. 6 (4),377–380*

13. *Nedunchezhian, N. and Dhandapani, S. (2000). Experimental investigation of cyclic variation of combustion parameters in a catalytically activated two-stroke SI engine combustion chamber. Engineering Today. 2, 11-18.*

14. *Usha Madhuri, T., Srinivas, T. and Ramakrishna, K.(2003). A study on automobile exhaust pollution with regard to carbon monoxide emissions, Nature, Environment and Pollution Technology. 2,473-478.*

15. *P. Baskaran & A. Naveenraj, "Experimental Study on a Spark Ignitio Engine Fuelled with Petrol and N-Butanol Blends", IJMPERD, Vol. 8, Issue 2, pp. 1143-1150*

16. *V.Sriram, Jeyajeevahan, G.Mageshwaran, G.Brittojoseph & R.B.Durairaj, Engine Performance and Emission Characteristics of 1-Octanol Blended Bio-Diesel in a Single Cylinder Diesel Engine, IJMPERD, Vol. 7, Issue 6, pp. 623-630*

17. *Shaik Abdur Rahman, G. S. Guru Dattatreya & N. Krishnarjuna Rao, "Experimental Investigation on Diesel Engine Fuelled with Blends of Coconut and Neem Oil", IJMPERD, Vol. 9, Issue 5, pp. 391–402*

18. *R T Naik & Nilesh Chavan, "Emission Characteristics of a High Speed Diesel Engine", International Journal of Mechanical Engineering (IJME), Vol. 5, Issue 4, pp. 29-36*